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E-Coaching: IVR-Enhanced Care Transition Support for Complex Patients

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Abstract

Purpose: The purpose of this study was to develop a care transition intervention that involved monitoring phone calls and home visits through "e-Coach," an Interactive-Voice-Response-supported (IVR) Care Transition coaching intervention. We developed and evaluated "e-Coach," by performing a randomized controlled trial (RCT) of this intervention versus a usual care comparison.

Scope: We developed and tested E-coach through focus groups, pilot testing and a RCT.

Methods: The design and execution of the intervention included the following: 1) development of an IVR monitoring system based on Coleman's care transition intervention; 2) development of a web-based "dashboard" of IVR responses that alert care transition nurses (CTN) of red flags identified after discharge; 3) pilot testing of the IVR system by patients and providers with subsequent refinement; and 4) formal testing through a RCT of the E-coach intervention in congestive heart failure (CHF) and chronic obstructive pulmonary disease (COPD) patients admitted to a large tertiary hospital.

Results: 511 patients were enrolled and randomized into the study (374 CHF and 137 COPD patients). Over 90% of participants answered 1 or more surveys. Almost one-third (29.2) answered all 7 surveys within the first 7 days. For the first call, 63.1% had one or more positive red flags. At 7 days, an average of 13.94 (SD=8.38) red flags were identified. There was no difference in the primary outcomes for CHF; however for COPD, patients receiving the intervention had fewer days in the hospital at 30 days (p=0.03) and lower rehospitalization rates (p=0.07). Priority populations served: inner-city; rural; low income; minority; elderly; and those with chronic care needs.

Key Words: care transitions; telehealth; interactive voice response

Final Report

Purpose

Our purpose was to develop and test an Interactive Voice Response (IVR) technology-enhanced Care Transition intervention to increase access and optimize resource utilization.

We chose this intervention approach for several reasons. First, it utilizes the telephone, a means of communication even more ubiquitous than the Internet. Second, the intervention is not limited by geographic distance. Finally, it allows care transition nurses to call only those patients with care-transition concerns rather than patients who are doing well and do not need their assistance.

Our aims were to:

1. Develop an IVR intervention to support care transitions in complex CHF and COPD patients.

2. Randomize patients to an IVR-supported Care Transition program ("e-Coach") versus usual care comparison.

3. Evaluate use of e-Coach by patients and healthcare providers.

4. Evaluate the impact of e-Coach (versus comparison) on patient outcomes, including community tenure.

Scope

Background and Context

For complex medical patients, the transition from hospital to home-based care is a vulnerable period, placing the patient at high risk for adverse events, including the experience of a medical error or loss of community tenure.

Approximately 20% of recently discharged patients experience adverse events [1, 2] often precipitated by ineffective communication. Out of 15,000 hospitalized patients, 11.9% reported new or worsening symptoms within 3 to 5 days of leaving the hospital. [3] One-quarter of post-hospitalization Medicare beneficiaries experienced one or more transfers from lower- to higher-intensity care environments within the first 30 days post-discharge, meeting the definition of a complicated care transition. Eight percent of these care transitions resulted in death during the 30-day post-hospitalization time period. [4] Clearly the period just after discharge is a risky time for complex patients.

Interventions have been tested to improve care transitions for complex hospitalized patients. Coleman and colleagues designed the Care Transitions Model based on focus groups

demonstrating gaps in four domains at discharge: 1) medication self-management, 2) lack of a patient-centered record owned and maintained by the patient to facilitate cross-site information transfer, 3) inconsistent follow-up with primary or specialty care, and 4) lack of knowledge by the patient or caregiver regarding warning signs and symptoms indicative of a worsening condition and instructions on how to respond to them.[5] Coleman's intervention addressed the four gaps in care with four pillars (medication management, patient-owned record, follow-up and patient/caregiver knowledge of warning signs or "red flags") of care that was coordinated by a transition nurse coach. The nurse coach scheduled an in-hospital meeting with the patient prior to discharge, with patient follow-up, first by home visit and then by telephone 3 times during a 28-day post hospitalization discharge period. In a randomized controlled trial, the intervention reduced rehospitalization rates by 30% at 30 days and 26% 90 days. Although the intervention reduced hospital costs in the intervention group as compared to the control ($2058 vs. $2546), the intervention required intensive resource allocation, to enable the transition coach to make home visits and proactive phone calls. As a result, the nurse coach was limited by the multiple demands, and could therefore only take care of 24 to 28 patients at any given time. [6]

Interactive voice response (IVR) systems allow for interaction between patient and databases using a standard telephone. IVR systems can obtain information from patients and deliver recorded telephone messages, instructions, reminders, or tailored education. From a health systems perspective, IVR and nurse support interventions may be cost-saving, with IVR providing the greatest benefit. [7] IVR systems have the distinct advantage of being accessible around the clock without geographic restriction. IVR interventions have demonstrated their efficacy in several clinical realms including screening, preventive services, and medication regimens. [8-10] Despite the flexibility of this technology, for reasons that are not completely clear, use of IVR to deliver health care remains relatively underdeveloped, especially for complex populations. [11]

Incidence and Prevalence of Care Transition Problems

Approximately 20% of hospitalized Medicare recipients are rehospitalized within 30 days of discharge. CHF and COPD are two of the three most common conditions associated with a rehospitalization with rates of 27 and 23% respectively. [12] One-quarter of Medicare beneficiaries posthospitalization experienced a complicated care transition within the first 30 days post-discharge, defined as one or more transfers from lower- to higher-intensity care environments. [13] Eight percent of these care transitions resulted in death during the 30-day post-hospitalization time period. In one study, two-thirds of post-discharge adverse events were due to adverse drug events. [1] Clearly the time period just after discharge poses a serious threat to complex patients.

Recent successful studies have used Coleman and colleague's Care Transition Intervention (CTI) which utilizes a nurse to conduct home visits, telephone follow-up, and provide assistance after discharge with: medication self-management, maintenance of a personal health record, timely follow-up with primary or specialty care, and identification of "red flags" indicative of a worsening condition. While successful, this model is costly and likely not feasible in many settings. [5] It is costly for nurses to provide home care and to initiate telephone follow-ups. Utilization of CTI in geographically dispersed populations is especially difficult. Thus, home-visit/telephone CTI interventions have not been routinely adopted into standard hospital discharge practices. [14-18]

Settings

Inpatient (recruitment and enrollment) and community-based care (follow-up).

Participants

Study sample included patients at high risk of transition-related errors—complex older adult patients discharged alive after a hospitalization with congestive heart failure (CHF) or chronic obstructive pulmonary disease (COPD) from geographically diverse areas across Alabama and six adjoining states. We chose these two conditions because of their high rates of readmissions and the complexity associated with their primary diagnosis, comorbid conditions and treatment regimens.

Methods

Intervention

The intervention was the e-Coach IVR-supported care transition system linked to a secure web-based interface. To improve transitional care, the IVR system actively called patients daily for one week and then daily or every 3 days up to 28 times (28 separate tailored questionnaires) after discharge. In a stepped-care approach, the IVR was supported by a Care Transition nurse who monitored patient symptoms through the e-Coach IVR data populated secure web-based interface and supported patient self-management through telephone-based interactions when needed.

We chose IVR monitoring to support the care transition experience, because it utilizes the telephone, a means of communication available to more patients than even the Internet, it is not limited by geographic distance; and allows care transition nurses to call only those patients with care-transition concerns rather than patients who are doing well and do not need their assistance. With e-Coach, Eric Coleman's four pillars of Care Transition support were linked to the IVR functions and examples of operationalization included [6]:

1. Medication self-management (Pillar 1): The IVR queried about their medications; any questions regarding medications or discrepancies identified through the IVR system alerted the Care Transition nurse via a web-based interface to follow up by telephone.

2. Use of a dynamic patient-centered record (Pillar 2): The IVR asked patients about the use of their patient health record for provider interaction and medication regimen clarification.

3. Primary care and specialist follow-up (Pillar 3): The IVR encouraged patients to follow-up with their providers after discharge and confirmed scheduled appointments. Those who stated to the IVR they had no follow-up appointment were called by the CTN; the CTN engaged in problem-solving dialogue with the patient about making a follow-up

appointment but did not make appointments for the patient as the goal of the intervention was patient activation not rescue.

4. Knowledge of warning signs and symptoms (Pillar 4): The IVR queried the patient daily for the first 7 days regarding symptoms potentially indicating worsening of their condition. Any worsening sign (e.g. excessive weight gain in CHF) or symptom (e.g. productive purulent cough in COPD) was sent as an alert to the dashboard monitored by the CTN, who then followed-up with the patient by telephone.

The IVR system noted as "red flags" to the CTN, patients who were having difficulty with any of the 4 pillars, including problems with medications, inability to obtain a follow-up appointment, worsening symptoms or confusion about their personal health record. Any patient who was noted to have a red flag was called by the CTN, who then used motivational interviewing techniques to assist them in addressing these red flags.

Comparison

The comparison was standard post-hospitalization care for CHF and COPD patients. Of note, care transition interventions became more common during the study period. Both at UAB and throughout the healthcare community due to the Center for Medicare and Medicaid Services' 9th Scope of Work that highlighted care transition interventions, a number of care transition interventions were rolled out during the study period. [19] Though not completely similar to e-Coach, many had some of the elements (including assurance of post-discharge follow-up and provision of educational materials) of the e-Coach intervention and likely influenced the readmission rates of the comparison group.

Randomization

Participants were identified through daily census lists and environmental scans of hospital floors that commonly admit patients with COPD or CHF. Written consent was obtained. After baseline data was collected, participants were randomized to the intervention or control using a permuted block randomized design with block sizes of 2 and 4. COPD and CHF patients had separate randomizations. Randomization was also stratified by health status (dichotomized SF1: excellent, very good and good vs. fair or poor) and race (White vs. Non-white).

Primary Outcome

The primary endpoint was rehospitalization rate at 30 days, which is one of the same measures proposed by the Center for Medicare and Medicaid Services for bundled payment. [20] Rehospitalization rate was assessed by patient/caregiver self-report at 1 week, 1 month, and 3 months via telephone interview. In addition, the data collection team obtained secondary outcome measures including 1) care transition experience and 2) cost (analyses pending).

Data Collection

Multi-phasic, longitudinal mixed method data collection using e-Coach IVR data collection, telephone follow-up and administrative records.

Statistical Analyses

All statistical tests were two-sided with a type-one error rate of 0.05. For primary analyses, chi-square tests were used to evaluate hypotheses involving proportions without adjustment for covariates while Student's t-test to test for differences in mean scores. The second level of analysis included logistic regression to model the odds of re-hospitalization and community tenure within 30 days with adjustment for gender.

Results

Participant Characteristics by Condition are shown in Table 1 and described below. The average age was 63. Over 40% of the study participants were African American; a little less than half were women. CHF patients had almost the same number of men and women but COPD patients were more likely to be white and male.

Table 1. Participant characteristics

Variable	CHF N	CHF %	COPD N	COPD %	p-value
Age: <55	96/346	27.7%	30/132	22.7%	0.07
Age: 55 to 64	87/346	25.1%	41/132	31.1%	
Age: 65 to 74	88/346	25.4%	43/132	32.6%	
Age: >=75	75/346	21.7%	18/132	13.6%	
Gender: Male	178/346	51.4%	73/132	55.3%	0.51
Gender: Female	168/346	48.6%	59/132	44.7%	
Race: White	165/346	47.7%	89/132	67.4%	0.00
Race: Black	175/346	50.6%	41/132	31.1%	
Race: Other	6/346	1.7%	2/132	1.5%	
Hispanic: No	345/346	99.7%	131/132	99.2%	0.93
Hispanic: Yes	1/346	0.3%	1/132	0.8%	
Education: <HS	59/346	17.1%	36/132	27.3%	0.02
Education: HS/GED	127/346	36.7%	56/132	42.4%	
Education Tech/Jun/Comm. College	92/346	26.6%	25/132	18.9%	
Education: ≥ College Grad	67/346	19.4%	15/132	11.4%	
Education: NA/Skipped	1/346	0.3%	0/132	0.0%	
Marital Status: Married	166/346	48.0%	58/132	43.9%	0.48
Marital Status: Not Married	178/346	51.4%	74/132	56.1%	
Marital Status: Refused/NA/Skipped	2/346	0.6%	0/132	0.0%	
Respondent: Patient	300/346	86.7%	110/132	83.3%	0.43
Respondent: Proxy	46/346	13.3%	22/132	16.7%	
Finances: No	110/346	31.8%	45/132	34.1%	0.35
Finances: Yes	235/346	67.9%	86/132	65.2%	
Finances: DK/Missing	1/346	0.3%	1/132	0.8%	

Table 1. Participant characteristics (continued)

Variable	CHF N	CHF %	COPD N	COPD %	p-value
Wilson's Health: Extremely	211/346	61.0%	74/132	56.1%	0.78
Wilson's Health: Quite A Bit	51/346	14.7%	23/132	17.4%	
Wilson's Health: Somewhat	45/346	13.0%	16/132	12.1%	
Wilson's Health: A Little Bit	18/346	5.2%	8/132	6.1%	
Wilson's Health: Not At All	21/346	6.1%	11/132	8.3%	
Smoking Status: Never	149/346	43.1%	12/132	9.1%	0.00
Smoking Status: Current	36/346	10.4%	39/132	29.5%	
Smoking Status: Former	161/346	46.5%	81/132	61.4%	

Most had a high school or greater (58%) education and slightly over half (53%) were not married. In addition to having a diverse population by gender and ethnicity, participants came from 53 of 67 counties in Alabama and 6 of its adjoining states (Georgia, Tennessee, Mississippi, Florida, Texas, Michigan).

Table 2. Participant characteristics by exposure

Variable	Total N	Total %	Control N	Control %	Intervention N	Intervention %	p-value
Age (Mean)	62.98	13.1%	63.27	13.4%	62.67	13%	0.61
Gender: Male	250/476	52.5%	141/244	57.8%	109/232	47%	0.02
Gender: Female	226/476	47.5%	103/244	42.2%	123/232	53%	
Race: White	252/476	52.9%	130/244	53.3%	122/232	53%	0.38
Race: Black	216/476	45.4%	108/244	44.3%	108/232	47%	
Race: Other	8/476	1.7%	6/244	2.5%	2/232	1%	
Hispanic: No	474/476	99.6%	244/244	100.0%	230/232	99%	0.46
Hispanic: Yes	2/476	0.4%	0	0.0%	2/232	1%	
Education: <HS	94/476	19.7%	47/244	19.3%	47/232	20%	0.81
Education: HS/GED	183/476	38.4%	96/244	39.3%	87/232	38%	
Education: Tech/Jun/Com College	116/476	24.4%	57/244	23.4%	59/232	25%	
Education: ≥College	82/476	17.2%	44/244	18.0%	38/232	16%	
Education NA/Skipped	1/476	0.2%	0/244	0.0%	1/232	0%	
Marital Status: Married	222/476	46.6%	112/244	45.9%	110/232	47%	0.95
Marital Status: Not Married	252/476	52.9%	131/244	53.7%	121/232	52%	
Marital Status: Refused/Missing	2/476	0.4%	1/244	0.4%	1/232	0%	
Respondent: Patient	408/476	85.7%	208/244	85.2%	200/232	86%	0.87
Respondent: Proxy	68/476	14.3%	36/244	14.8%	32/232	14%	
Financial Security: No	155/476	32.6%	77/244	31.6%	78/232	34%	0.53
Financial Security Yes	319/476	67.0%	166/244	68.0%	153/232	66%	
Financial Security: DK/Missing	1/476	0.2%	1/244	0.4%	0/232	0%	
Health Status: Extremely	285/476	59.9%	148/244	60.7%	137/232	59%	0.55
Health Status: Quite A Bit	73/476	15.3%	36/244	14.8%	37/232	16%	
Health Status: Somewhat	61/476	12.8%	34/244	13.9%	27/232	12%	
Health Status: A Little Bit	25/476	5.3%	9/244	3.7%	16/232	7%	
Health Status: Not At All	32/476	6.7%	17/244	7.0%	15/232	6%	

Table 2 shows that participant characteristics were all balanced with the exception of gender; as more men were in the control group among those with COPD. Therefore, in all subsequent analyses, gender was included as covariate in the regression models.

Dosing of the Intervention

One challenging element of a multi-component intervention in measuring impact relates to the "dosing" of the intervention. In the case of e-Coach, a full dose of the intervention would entail answering all 28 calls from the IVR system. Optimal dosing would be a daily response to the IVR system during the first seven days. In the trial, dosing of the intervention varied greatly. Over 90% (91.2) participants answered 1 or more surveys. Almost one-third (29.2) answered all 7 surveys within the first 7 days. On average it took 12 days for participants in the intervention group to answer the first 7 surveys.

For the first call, 63.1% had one or more red flags (see Intervention) suggesting a fairly high level of need post-discharge among these CHF and COPD patients. Red flags indicated answers from the patient that warranted a follow-up all by the care transition coach. At 7 days, for those in whom red flags, an average of 13.94 (SD=8.38) red flags were identified over the course of the first week post-discharge.

Primary Outcomes

In survival analyses for CHF, no clear benefit for the intervention was evident; on the other hand, for COPD, the intervention seemed to reduce rehospitalizations or death, especially during days 15-30.

Table 3 highlights the primary outcomes of interest between the intervention and comparison groups. In the CHF group, we did not see any difference in the primary outcomes of interest between the intervention and the comparison group. In the COPD group, we saw trends for reduced rehospitalizations and death in the intervention group and a statistically significant difference in the number of days patients were in the hospital and out of the community in the first 30 days, between the intervention group and comparison group.

Table 3. Primary outcome

Outcome	Days	CHF Control: N/ mean	CHF Control: %/sd	CHF Interv.: N/ mean	CHF Interv.: %/sd	CHF: P	COPD Control: N/ mean	COPD Control: %/sd	COPD Interv: N/ mean	COPD Interv: %/sd	COPD: P
Rehospitalization or Death	30	31	17.4	30	17.9	0.973	16	23.9	8	12.3	0.134
Rehospitalization or Death	90	56	31.5	62	36.9	0.340	29	43.3	23	35.4	0.453
Rehospitalization	30	26	14.6	27	16.1	0.819	14	20.9	8	12.3	0.276
Rehospitalization	90	48	27.0	54	32.1	0.348	26	38.8	22	33.8	0.681
Death	30	5	2.8	4	2.4	0.930	2	3.0	0	0.0	0.490
Death	90	10	5.6	13	7.7	0.565	4	6.0	1	1.5	0.380
Days out of community	30	1.48	4.1	1.62	4.6	0.765	1.6	3.5	0.52	1.8	0.039
Days out of community	90	5.46	14.4	6.43	15.5	0.551	6.14	14.1	4.17	8.1	0.333

For COPD patients, those receiving the intervention had fewer deaths and rehospitalizations (p=0.13) and significantly fewer days out of the community in an institutional setting (P=0.03). When those readmitted during the first 7 days posthospitalization were excluded, the Hazard Ratio for hospital readmission among the COPD intervention group was 0.42 (p=0.07).

Discussion

We successfully developed and completed a computer telephony e-intervention with patients from a diverse population receiving outpatient care in multiple health care settings. Use of the intervention was high. Many red flags were identified, suggesting a real need for post-discharge care and follow-up. In our main analysis we found a difference between CHF and COPD in the effect of the intervention, with COPD patients more likely to benefit from the standpoint of community tenure and rehospitalization, and with CHF patients no benefit demonstrated.

Other recent studies have not consistently demonstrated a benefit for an IVR-enhanced intervention for CHF. To our knowledge, this is the first study using IVR-enhanced care transition support for COPD. A number of possibilities might explain this difference. The CHF intervention may have had no effect or potentially increased rehospitalizations due to the complexity of the condition and the fact that medication management decisions often require provider involvement. Because this was a patient self-management and patient activation intervention that did not rescue the patient by calling his/her provider, the patients' interaction with their provider and with the health care system was contingent on their successful use of the strategies suggested to them by the care transition coaches. If the condition's or system's complexity prevented successful interaction, then, in fact, the intervention may have increased rehospitalization. For example, a CHF patient notices more shortness of breath and is encouraged by his/her coach or by the IVR system to contact his provider. If his/her provider is not able to see the patient, he/she could be sent to the emergency room and subsequently admitted. The COPD-intervention may have increased community tenure because the intervention focused on self-management support and addressed issues that COPD patients could address without provider involvement. For COPD patients, medication titration may have been less of a need and therefore, interaction with the provider for guidance on medication changes (as is common with diuretics in CHF) would be less common.

Next Steps

As an implementation science intervention, the health care system took an active role in the design of the website used by the coaches to follow patients in the intervention. With the close of the study, the coaches have now been hired to engage in care transition coaching throughout the hospital.

With respect to research, important next steps are to better understand what elements of the intervention can be broadened for populations without COPD and CHF and what elements are most important for effective care transitions.

Conclusion

IVR-enhanced care transition support is a feasible intervention that has the capability to overcome geographic boundaries. It appears to be particularly effective for complex patients with COPD. Patients in this study met multiple criteria for complexity—the complexity of their illness, geographic challenges with respect to access to medical care, and for some, significant resource disadvantages. E-Coach demonstrated that it was able to overcome these challenges in complexity by offering a simple phone-based monitoring and patient activation tool for chronically ill, hospitalized patients to support them in their transition home.

Significance

This study highlights the feasibility of an IVR-enhanced coaching intervention among adults with chronic serious illnesses. It also demonstrated variation in benefit of self-management support by condition. The study suggests that IVR-enhanced self-management support may have differential effects on healthcare utilization, depending on condition. This study focused on several priority population groups: minority groups; women; older adults and those with significant chronic care needs.

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List of Publications and Products

Submitted for Publication

Ritchie C, Richman J, Sobko H, Bodner E, Houston T. The E-Coach Transition Support Computer Telephony Implementation Study: Protocol of a Randomized Trial. *Contemporary Clinical Trials*. In press.

In Preparation

Ritchie C, Houston T, Becker D, Berner E, Callans W, Locher J, Sobko H, Richman J. Differential Effect of an IVR-Enhanced Care Transition Intervention on COPD and CHF Patients. To be submitted to *JAMA*.

Products

E-Coach IVR Scripts and Branching Logic for COPD

E-Coach IVR Scripts and Branching Logic for CHF